The effectiveness of constructivist learning supported by smart applications in developing reading comprehension skills among graduate students in a reading course in the English language

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Abstract: The present study aimed to measure the effectiveness of constructivist learning supported by smart applications in developing reading comprehension skills among graduate students enrolled in an English Reading course. To achieve this objective, the study adopted an experimental approach using a quasi-experimental design based on two groups: a control group and an experimental group. A test specification table, a reading comprehension skills test, and a performance observation checklist were developed as study tools. The study sample consisted of 40 graduate students enrolled in the Master's program in Educational Technology at the College of Education, Al-Baha University. The sample was randomly divided equally into two groups. Statistical analysis methods, including the independent-samples t-test and Cronbach's alpha coefficient, were used for data processing. The results indicated the effectiveness of constructivist learning supported by smart applications in enhancing reading comprehension skills in the English Reading course. The study found statistically significant differences at the (0.01) level between the mean scores in the post-reading comprehension test in favor of the experimental group, with an effect size greater than (0.8). Additionally, statistically significant differences were observed at the (0.01) level between the mean scores of the experimental and control groups in the post-test performance observation checklist, favoring the experimental group.

In light of these findings, the researcher recommends using constructivist learning supported by smart applications in teaching the English Reading course, as well as in teaching various skills and concepts.

Keywords: constructivist learning, smart applications, reading comprehension.

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فاعلية التعلم البنائي المدعوم بالتطبيقات الذكية في تنمية مهارات الفهم القرائي لدى طلبة الدراسات العليا بمقرر قراءات باللغة الانجليزية

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مستخلص البحث: هدفت الدراسة الحالية إلى قياس فاعلية التعلم البنائي المدعو بالتطبيقات الذكية في تنمية مهارات الفهم القرائي لدى طلبة الدراسات العليا بمقرر قراءات باللغة الإنجليزية، ولتحقيق هذا الهدف تم اتباع المنهج التجريبي بتصميمه شبة التجريبي القائم على المجموعتين الضابطة والتجريبية، وتم اعداد جدول مواصفات واختبار لقياس مهارات الفهم القرائي وبطاقة ملاحظة الأداء كأدوات للدراسة، وتكونت عينة الدراسة من (40) طالب وطالبة من طلبة الدراسات العليا ببرنامج ماجستير التربية في تكنولوجيا التعليم بكلية التربية جامعة الباحة، وتم تقسيم العينة بالتساوي بطريقة عشوائية، وتم استخدام المعالجة الإحصائية المتمثلة في اختبار(ت)، ومعامل ألفا كرونباخ. وأسفرت نتائج الدراسة أن فاعلية التعلم البنائي المدعوم بالتطبيقات الذكية في تنمية مهارات الفهم القرائي لمقرر قراءات باللغة الإنجليزية، حيث أظهرت الدراسة وجود فروق ذات دلالة احصائية عند (0.01) بين متوسطات درجات اختبار الفهم القرائي في التطبيق البعدي لصالح المجموعة التجريبية وحجم تأثير أكبر من (0.8)، كما أظهرت النتائج وجود فروق ذات دلالة احصائية عند مستوى (0.01) بين متوسطي درجات المجموعة التجريبية والمجموعة الضابطة في التطبيق البعدي في بطاقة الملاحظة لصالح المجموعة التجريبية، وفي ضوء هذه النتائج يوصي الباحث باستخدام التعلم البنائي المدعوم بالتطبيقات الذكية في تدريس مقرر قراءات باللغة الانجليزية وفي تدريس المهارات والمفاهيم المختلفة.

الكلمات مفتاحية: التعلم البنائي، التطبيقات الذكية، الفهم القرائي.

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1. Introduction

The world is currently witnessing a significant renaissance in all aspects of life, making it essential for all members of society to keep pace with these advancements. Since future generations will be responsible for sustaining this progress, there is a strong emphasis on education and its development to create a generation capable of contributing to continuous growth. The technological revolution has greatly influenced the educational process, with students now deeply engaged in smart applications that open up vast learning opportunities. As a result, new learning patterns have emerged, relying on modern technologies to create interactive learning environments that enhance critical thinking and problem-solving skills .Smart applications provide personalized and diverse educational content tailored to students' learning levels and interests, encouraging exploration and self-directed learning. They also offer tools for instant assessment and performance analysis, enhancing engagement and effective interaction between learners and educational content (Vachliotis & Tzougraki, 2021).

Foreign language education is both a scientific and practical necessity in contemporary life, which is characterized by an information revolution driven by advancements in communication technology. These developments have helped break down barriers between cultures and nations. Learning foreign languages fosters cultural openness and helps individuals adapt to global technological and scientific progress. Additionally, current global trends highlight the need for intercultural communication and dialogue among nations, further emphasizing the importance of foreign language education (Salah Al-Din, 2024).

Al-Khatib (2024) argues that constructivist learning helps in the development of English language and reading comprehension skills, such as text exploration, speed reading, inference, identifying main ideas, understanding paragraph structures, and expressing ideas in English. This is achieved through technology-driven interactive educational content tailored to individual learner needs. Similarly, Kim & Adlof (2024) highlight that smart applications improve text comprehension, vocabulary expansion, and reading skills within flexible, engaging and effective learning environments. These applications also promote self-directed learning, allowing students to engage with content anytime and in ways that suit their preferences.

1.1 The Study Problem:

Through the researcher's experience teaching the English Reading course to graduate students in the Master's Program in Educational Technology, a noticeable decline in students' reading comprehension skills was observed. To validate this, interviews were conducted with faculty members teaching the same course, confirming significant deficiencies in these skills. A preliminary study further revealed that approximately 80% of students needed improvement in reading comprehension. Only 10% could interpret and infer meaning from English texts, 6% demonstrated critical analysis skills, and just 4% could provide appropriate solutions and alternatives, indicating widespread skill gaps.

Previous studies, such as those by Ardiansyah & Ujihanti (2018) and Smith & Hammond (2021), have emphasized the importance of developing reading comprehension skills across educational levels. Additionally, research by Shahada and AlQaramiati (2016), Abiri (2019), and AlJazra (2020) has highlighted a decline in academic achievement due to the reliance on traditional teaching methods and the lack of modern instructional strategies.

In this context, the current study aims to investigate the effectiveness of constructivist learning using smart applications as a modern strategy to enhance reading comprehension skills in an English reading course. The core research question is: What is the effectiveness of constructivist learning supported by smart applications in developing reading comprehension skills among graduate students in a reading course in the English language? This leads to several sub-questions addressing specific aspects of this issue.

1. What is the effectiveness of constructivist learning supported by smart applications in developing the cognitive aspect of reading comprehension skills among graduate students in a reading course in the English language?
2. What is the effectiveness of constructivist learning supported by smart applications in developing the performance aspect of reading comprehension skills among graduate students in a reading course in English?
3. Is there a statistically significant relationship at the ($\alpha \leq 0.05$) level between the mean scores

of the experimental group students (who were taught using constructivist learning with smart applications) in the posttest for the cognitive test and the observation checklist of reading comprehension skills?

1.2 Objectives of the Study:

The study aims to achieve the following objectives:

1. To measure the effectiveness of constructivist learning supported by smart applications in developing the cognitive aspect of reading comprehension skills among graduate students in a graduate-level English reading course.
2. To examine the effectiveness of constructivist learning supported by smart applications in developing the performance aspect of reading comprehension skills among graduate students in a graduate-level English reading course.
3. To determine the existence of a statistically significant relationship at the ($\alpha \leq 0.05$) level between the mean scores of the experimental group (which was taught using constructivist learning integrated with smart applications) in the posttest of the cognitive assessment and the reading comprehension skills observation checklist.

1.3 Significance of the Study:

The significance of this study can be seen in the following aspects:

1. Theoretical Significance:

The study aligns with global educational frameworks that highlight the importance of improving students' reading comprehension skills through modern learning tools, moving away from traditional methods that no longer meet the needs and demands of the 21st century generation.

2. Practical Significance:

This study is anticipated to contribute by:

A. Directing the attention of policymakers to the importance of constructivist learning powered by smart applications in education and its effectiveness in developing reading comprehension skills.

B. Investigating how the combination of constructivist learning and smart applications can effectively improve reading comprehension skills.

1.4 Hypotheses of the Study:

1. There are no statistically significant differences at the level ($\alpha \leq 0.05$) between the average scores of the experimental group and the average scores of the control group in the post-application of the cognitive aspect of reading comprehension skills among graduate students in a reading course in the English language, in favor of the experimental group...
2. There are no statistically significant differences at the level ($\alpha \leq 0.05$) between the average scores of the experimental group and the average scores of the control group in the post-application of the note card for the performance aspect of reading comprehension skills among postgraduate students in a reading course in the English language, in favor of the experimental group.
3. There is no statistically significant relationship at the level ($\alpha \leq 0.05$) between the average scores of male and female students in the experimental group in the post-application of the cognitive test and the reading comprehension skills note card.

1.5 Limitations of the study

1. Subjective Limitations: The study was limited to reading comprehension skills (literal, inferential, critical, and creative) within the English reading course curriculum.
2. Human Limitations: The study focused on graduate students enrolled in the Master of Education in Educational Technology program.
3. Spatial Limitations: The study was conducted at the College of Education, AL Baha University.
4. Temporal Scope: This study was carried out during the second semester of the academic year 1446 AH.

1.6 Study Terminology:

1. Concept of Constructivist Learning:

Constructivist learning is "an educational approach that focuses on building knowledge and learning through active interaction with the surrounding environment. This model is based on the idea that the learner constructs their own understanding through personal experiences and encounters" (Kasna, S., & Novrianti, 2023, p. 134).

The researcher defines it operationally as the learning approach in which students build their knowledge by interacting with the educational content (reading comprehension skills for the English course) and actively participating in the learning process.

1.7 Smart Applications:

Al-Jazrah (2020, p. 13) defines them as digital tools that can be downloaded onto smartphones or tablets, used to assist and enhance specific tasks such as learning, entertainment, or productivity. These applications are distinguished by their ability to interact with users, provide instant feedback, personalize content based on user needs, and support self-directed learning through user-friendly interfaces.

Operationally, the researcher defines them as innovative digital tools that can be used to support English language learning, such as applications that provide instant feedback and interactive learning experiences. An example is the "Duolingo" app for learning English, which offers interactive exercises with immediate feedback on correct and incorrect answers, allows users to choose different learning levels, and adjusts content based on the learner's progress.

1.8 Constructivist Learning Using Smart Applications:

Jonassen and Land (2000) describe constructivist learning through smart applications as an educational approach where students actively interact with smart technologies, constructing knowledge based on personal experiences, engaging with digital learning environments, and utilizing smart applications to analyze information, thereby fostering critical thinking and problem-solving skills. The researcher refers to constructivist learning using smart applications as learning that involves utilizing smart applications by providing interactive tools and environments that enable students to engage with the content of the English Reading course and offer platforms for collaboration among students, such as group discussions.

1.9 Reading Comprehension Skills:

Liu & Lu (2020, p. 246) define reading comprehension skills as "the ability to understand and analyze written texts in a specific language," relying on interactive strategies that help students absorb and analyze texts in various ways. Operationally, the researcher defines these skills as those that enable students to engage deeply with English texts, enhancing their understanding and interpretation of different meanings. This study focuses on four key reading comprehension skills:

Literal Reading Comprehension: The ability to understand explicit information directly stated in the text, answering questions based on clear content.

Inferential Reading Comprehension: The ability to deduce implied meanings using textual clues, going beyond the literal words to infer hidden ideas.

Critical Reading Comprehension: The skill of evaluating and analyzing ideas, assessing the credibility and quality of the presented information.

Creative Reading Comprehension: Using the text as inspiration to generate new ideas, offer fresh perspectives, or develop innovative solutions based on the content.

Theoretical Framework and Previous Studies:

First: Theoretical Framework

First Axis: Constructivist Learning Using Smart Applications

Concept of Constructivist Learning:

Constructivist learning is an educational theory emphasizing that learners build their own knowledge through engagement with educational content and personal experiences. Sasan and Rabillas (2022, p. 48) state that knowledge is not directly transmitted from teacher to student but is constructed through stages of exploration, discussion, and evaluation. Similarly, Chuang (2021) explains that constructivist learning relies on students' interaction with information, shaped by their prior experiences and critical thinking.

In the digital age, constructivist learning can be effectively integrated with smart applications, offering an interactive, flexible, and innovative learning environment. This approach shifts the focus to the learner, making them the center of the learning process, while the teacher acts as a guide and facilitator. Smart applications present educational content alongside interactive activities, allowing students to engage actively and solve tasks using technological tools. Thus, this model combines self-directed learning with the development of diverse skills and experiences.

Goals of Constructivist Learning Using Smart Applications:

The goals of constructivist learning, as outlined by Akasha (2022), include the following:

1. Involving students as collaborators in the creation and enhancement of materials that facilitate their learning.
2. Organizing skills for internet searching. .
3. Developing individual skills among students.
4. Making learning more effective by creating an environment that stimulates learning.

From the above, it is clear that the aim of constructivist learning using smart applications is to enhance education, move beyond traditional teaching methods, and avoid their shortcomings by utilizing technology and the internet in the educational process. The researcher believes that smart applications contain interactive features that provide students with an innovative learning environment capable of offering them comprehensive and flexible learning experiences, which helps deepen understanding and develop skills, ultimately making the learning process more effective and of higher quality.

2. Importance of Constructivist Learning:

Constructivist learning is crucial in education, as outlined by Tyagi & Sivakumar (2024). Its significance includes:

1. Developing various skills like critical thinking, creativity, self-learning, and collaboration among students.
2. Maximizing class time for discussions and practical applications to enhance skill development.
3. Shifting focus to students and increasing their responsibility for their learning.
4. Incorporating modern technologies to improve the learning process.
5. Improving efficiency and quality in education while saving time and effort.
6. Reorganizing the educational process and promoting the optimal use of technology and tools.

Research by Shwedeh & Uppilappatta (2023) and Tyagi & Sivakumar (2024) confirms that constructivist learning boosts achievement, develops skills, and changes the roles of both teachers and students. It allows teachers to spend more time with students and support those who need extra help. Constructivist learning integrates smart applications, enhancing student's active participation in the learning process. It places students at the center, making them active participants while teachers guide and support them. This approach also accommodates individual differences, helping students meet learning objectives effectively.

Chitt & Kumar (2024) highlight several types of smart applications in education:

- **Reading and Interaction Apps:** Offer interactive texts with audio and video aids.
- **Language Skills Training Apps:** Help students learn vocabulary and grammar in an engaging manner.
- **Instant Feedback Apps:** Provide quick feedback on answers to promote self-correction.
- **Collaboration Apps:** Enable students to collaborate, share ideas, and give feedback on educational materials.

- **Second Axis:** Reading Comprehension Skills for the English Language

Concept of Reading Comprehension:

Reading comprehension is defined by Nerim (2020, p. 135) as "the ability to understand and analyze written texts," which is a crucial skill for students learning the English language. To achieve a high level of reading comprehension, students must develop various abilities. Mohamed (2023) identifies seven key skills for English language learners, including text exploration, rapid reading, inference, focusing on the main idea, understanding paragraphs, identifying sentence structures, and expressing ideas in English. Tong & Deacon (2024) categorizes these skills into three levels: the word level, the sentence level, and the paragraph level. Abenojar (2024) further classifies reading comprehension into four levels: literal comprehension, inferential comprehension, critical comprehension, and creative comprehension.

This study focuses on four specific reading comprehension skills: literal, inferential, critical, and creative. The researcher suggests that applying a constructivist learning approach, supported by smart applications, can significantly enhance these competencies. Smart applications provide an interactive learning environment where students can read texts, answer related questions, engage in discussions with peers and teachers, and receive immediate feedback. This process allows students to correct mistakes, develop their comprehension skills, and engage in critical thinking, deepening their understanding. Activities that prompt discussion and analysis also stimulate critical thinking, encouraging students to explore texts in various ways.

Constructivist Learning Theory and Smart Applications in Enhancing Reading Comprehension in English:

Constructivist learning theory, developed by Jean Piaget, emphasizes that students should actively construct their own knowledge rather than passively receiving it from the teacher. According to Zarrinabadi & Ebrahimi (2019), the key principles of this theory include:

Students should actively engage in constructing knowledge independently through exploration and critical thinking.

Critical thinking is essential for effective knowledge transfer, where the teacher facilitates rather than directly imparts information.

Students must continuously build and refine their knowledge to promote conceptual change.

Assessing learners' opinions is crucial for gaining insights and improving the learning process.

When applied with smart applications, the constructivist theory can significantly improve English reading comprehension skills. By encouraging students to independently build linguistic knowledge and engage with texts actively, they can develop deeper understanding and critical thinking. Smart applications like interactive reading apps, which offer texts alongside activities like instant translation or word analysis, provide a rich context for improving reading comprehension. Additionally, the use of videos or audio simulations can demonstrate how words or phrases are used in various contexts, helping expanding students' understanding. Creating short quizzes or interactive tasks that provide immediate feedback further reinforces learning and improves reading skills. Through these tools, constructivist learning enables students to explore, analyze, and gain deeper insights into texts, thereby enhancing their reading comprehension abilities.

Second: Previous Studies Related to the Study Variables:

The study by Issa and Mansour (2015) aimed to assess reading comprehension skills and awareness of strategies among education college students, and explore their relationship with variables like study years, academic performance, and gender. The researchers developed a list of reading comprehension skills, a test, and a scale for measuring comprehension

strategies awareness. The sample consisted of 108 male and 201 female students from Taif University's College of Education. Results indicated that students generally displayed weak reading comprehension skills, highlighting a need for improvement in these areas. The study also proposed a program to enhance students' reading comprehension abilities and strategies.

The study by Ardiansyah and Ujihanti (2018) examined student performance in reading comprehension, vocabulary mastery, and ethical values among third-semester students at Politeknik Negeri Sriwijaya, Indonesia. Using a research and development (R&D) methodology, the study focused on 148 students from high-achieving and low-achieving classes. Data were collected through reading comprehension and vocabulary tests, analyzed using paired t-tests. Results showed significant improvements in reading comprehension and vocabulary mastery for both groups. Additionally, students demonstrated positive ethical values, such as cooperation and responsibility, which enhanced their reading experience. The researchers recommended adopting a social constructivist-based approach for teaching reading comprehension.

The study by Bower (2019) focused on the design of mobile-assisted learning, where the researcher reviewed best practices for designing mobile applications that support constructivist learning, such as reading comprehension applications using smartphone technology. The study discussed how to design student-centered applications based on constructivist principles, emphasizing features such as interactivity and personalization.

Similarly, the study by Chen & Lee (2020) aimed to examine the impact of a mobile-assisted program on improving English reading comprehension skills in a constructivist learning environment. The researchers utilized mobile technology to provide interactive educational resources that help students enhance their reading comprehension through various activities, such as reading texts and completing exercises after reading.

The research by Liu & Lu (2020) investigated how participatory classroom activities influenced ESL learners' reading comprehension and strategic reading readiness. Set within a two-month strategy-based reading program grounded in a constructivist framework, the program aimed to improve academic reading skills. Using a quasi-experimental design, the study included a control group and an experimental group of ESL students from China. Results showed that the strategy-based intervention significantly improved students' use of reading strategies and boosted their comprehension. The study also considered the impact of Chinese students' learning cultures, providing suggestions for future research in this area.

Zajda (2021) explored innovative approaches to transform traditional educational methods and assess their effectiveness. This case study took place in an ESL class at No. 9 Middle School in Bengbu, China. It compared online education with traditional textbook-based methods for improving reading skills. A survey was conducted at the semester's end, and data analysis revealed that online education was more effective. Students gained more knowledge through the internet, leading to improved reading skills, higher motivation, better engagement, and significant exam performance improvement, thus creating a positive educational environment.

Mohamed (2023) examined the use of multimedia software in teaching English from the perspective of middle school teachers. Using a descriptive approach, the study surveyed 96 female teachers with a 41-item questionnaire. The results revealed no significant differences in teachers' mean scores based on training for the first and third dimensions of the questionnaire at the 0.05 significance level. However, significant differences were found for the second dimension. Additionally, differences were observed based on teachers' practical experience, but no significant differences in the total score. The study recommended training teachers in effective multimedia software use and continuous software development to keep up with technological advancements.

Commentary on Previous Studies:

Some studies have emphasized the importance of reading comprehension, such as the studies by Issa, and Mansour (2015), Ardiansyah & Ujihanti (2018), and Liu & Lu (2020). The current study differs from these studies in terms of the sample applied, as it focused on graduate students. It also differs from previous studies in terms of the temporal and spatial boundaries. To the best of the researcher's knowledge, there has been no study addressing the effectiveness of constructivist learning using smart applications in enhancing reading comprehension in the English language.

How the Researcher Benefited from the Theoretical Framework and Previous Studies:

The researcher benefited from the theoretical framework in forming a clear understanding of constructivist learning using smart applications, which helped in determining the appropriate pattern and then identifying the suitable reading comprehension skills. The researcher was also able to support the study's problem and define its terminology through this framework. Furthermore, the previous studies helped in gathering and preparing the theoretical framework, constructing the study tools, and selecting the appropriate methodology.

3. Method and Variables of the Study

The researcher employed an experimental method with a quasi-experimental design, as it was suitable for achieving the objectives of this study, which aims to explore the effectiveness of the independent variable (constructivist learning using smart applications) on the dependent variable (enhancing reading comprehension skills for an English reading course). The reading comprehension skills targeted were: literal, inferential, critical, and creative.

4. Population and Sample of the Study:

Population: The study population consists of all male and female graduate students enrolled in the Master's program in Educational Technology at the College of Education, Al-Baha University.

Sample: The sample size consists of 40 students, who were divided into two groups: an experimental group of 20 students, who studied using constructivist learning powered by smart applications, and a control group of 20 students, who studied using the traditional method. The study sample was selected randomly.

5. Normality and Homogeneity Testing:

The normality of data distribution in both the experimental and control groups was verified using the Shapiro-Wilk test. The p-values for each group were greater than 0.05, indicating that the data followed a normal distribution. Therefore, an independent t-test was used to compare the mean scores between the two groups.

Sample: The sample size consists of 40 students, divided into two groups: one experimental group studying using constructivist learning with smart applications (20 students), and one control group studying using the traditional method (20 students).

6. Experimental Design of the Study:

Table 1: Experimental Design of the Study

Group	Pre Test	Intervention	Post Test
Control Group	Pre Test, Observation Checklist	Traditional Method (Conventional Teaching)	Post Test, Observation Checklist
Experimental Group		Constructivist Learning Using Smart Apps	

This table outlines the structure for measuring reading comprehension skills before and after applying different teaching methods to both the control and experimental groups.

7. Study Tools:

The study tools consisted of two instruments:

A Reading Comprehension Skills Test in English. (Prepared by the researcher)

An Observation Checklist for English Reading Comprehension Skills. (Prepared by the researcher)

7.1 First: The Reading Comprehension Skills Test in English:

The researcher developed the reading comprehension skills test based on topics from the English reading course, following these steps:

Determine the purpose of the test and its dimensions:

The aim of the test was to measure the level of reading comprehension skills of graduate students (the study sample) according to the learning objectives as outlined in the curriculum. The researcher also prepared a test specifications table to guide the distribution of the test questions, ensuring the comprehensiveness of the test and a good representation of the course content. The test consisted of 26 items with a total score of 26 points, based on the relative weight of the topics and objectives.

7.2 Test Design:

The researcher developed the reading comprehension test based on a set of previous studies that focused on the topic of reading comprehension. **Test Scoring:** One point was awarded for each correct response, and zero points for each incorrect response, so the total score a student could achieve ranged between 0 and 26 points. **Test Instructions:** The researcher provided a set of instructions for the students, which included clarifying the test's purpose, specifying the number of questions, indicating the time allowed for answering, and guiding the students on the importance of answering all questions and not selecting more than one answer. **Test Validity:** The researcher verified the validity of the test through the following methods:

8. Face Validity of the Test Content:

The initial version of the cognitive test was presented to a panel of 10 experts in educational technology, curriculum, and English language teaching methods. The test was accompanied by an introduction explaining the study's purpose, title, and the test's objectives to ensure face validity. The experts provided feedback on:

The accuracy and clarity of the language.

The appropriateness of the test content for the sample students.

The diversity of knowledge and skills assessed.

The experts approved most of the test questions, suggesting some modifications to the wording of certain items. The researcher made the necessary adjustments based on their recommendations, thus confirming the content validity of the test.

9. Internal Consistency of the Test Items:

Internal consistency was assessed using Pearson's correlation coefficient between the scores of each item and the total score of the dimension. Table (2) illustrates these correlations:

Table2: Correlation Coefficients between Each Item Score and the Total Dimension Score (n = 30)

Literal Comprehension		Inferential Comprehension		Critical Comprehension		Creative Comprehension	
Item (M)	Correlation Coefficient	Item (M)	Correlation Coefficient	Item (M)	Correlation Coefficient	Item (M)	Correlation Coefficient
1	0.625**	1	0.487**	1	0.721**	1	0.624**
2	0.587**	2	0.654**	2	0.529**	2	0.512**
3	0.532**	3	0.508**	3	0.648**	3	0.498**
4	0.514**	4	0.551**	4	0.552**	4	0.598**
5	0.625**	5	0.614**	5	0.573**	-	-
6	0.693**	6	0.532**	6	0.621**	-	-
7	0.573**	7	0.518**	7	0.629**	-	-
8	0.447**	-	-	-	-	-	-

****Significant at the 0.01 level.**

It is clear from Table (2) that all the questions of the tool have positive and statistically significant correlation coefficients at the (0.01) level, meaning that they exhibit internal consistency.

Internal consistency of the dimensions with the total score:

The correlation coefficients were calculated using Pearson's correlation coefficient between the dimensions with each other, on the one hand, and the correlation of each dimension with the total score, on the other. Table (3) illustrates this:

Table3: Correlation matrix of the tool's dimensions.

No	Dimensions	First	Second	Third	Fourth	Total
1	Literal Comprehension	-				
2	Inferential Comprehension	0.611**	-			
3	Critical Comprehension	0.578**	0.620**	-		
4	Creative Comprehension	0.608**	0.584**	0.475**	-	
Total Score		0.588**	0.662**	0.532**	0.617**	-

****Significant at the 0.01 level**

It is clear from Table (3) that all the correlation coefficients are significant at the 0.01 level, indicating that the tool exhibits internal consistency.

10. Reliability of the Tool:

10.1 Reapplication of the research tool

The reliability was assessed by re-administering the tool to the same sample after a two-week interval to verify its psychometric properties. Pearson's correlation coefficients were calculated between the scores of the sample, and all correlation coefficients were significant at the 0.01 level, suggesting that the tool produces consistent results when used multiple times under similar conditions.

Table4: Reliability Results through Reapplication Method.

Dimensions	Correlation Coefficient between First and Second Applications	Significance Level
Literal Understanding	0.628	0.01
Interpretation	0.847	0.01
Prediction	0.762	0.01
Decision Making	0.784	0.01
Total Score	0.773	0.01

The correlation coefficients are significant at the 0.01 level, indicating strong reliability of the tool.

It is clear from Table (4) that there is a statistically significant correlation between the first and second applications, indicating the tool's reliability, which confirms its validity in measuring the trait it was designed for.

10.2 Cronbach's Alpha Method:

The reliability coefficient of the tool was calculated using Cronbach's Alpha, and all values were high, indicating an appropriate level of reliability. The results are shown in Table (5):

Table 5: Reliability Coefficients of the Tool Using Cronbach's Alpha

No.	Dimensions	Cronbach's Alpha Coefficient
1	Literal Understanding	0.807
2	Interpretation	0.762
3	Prediction	0.781
4	Decision Making	0.776
	Total Score	0.813

These Cronbach's Alpha values indicate that the tool has a high level of reliability.

It is clear from Table (5) that the reliability coefficients are high, which provides a good indicator of the tool's reliability, and based on this, the tool can be used effectively.

Second: Reading Comprehension Skills Observation Checklist

The researcher followed these steps in preparing the observation checklist for the current study:

Determining the Purpose of the Observation Checklist:

The checklist aimed to measure the performance rate of reading comprehension skills in the English readings course before and after exposure to the program.

Identifying the Performance Indicators Included in the Checklist:

The main areas where the required skills related to the program could be observed were identified and distributed across the educational units of the program, in line with the skill list framework. The skills (main and subs kills) identified were distributed into four main areas: literal, inferential, critical, and creative comprehension. Each main area includes several subs kills. These areas were then compiled into the reading comprehension skills checklist, which includes (4) main skills and (12) subs kills. Care was taken to arrange the skills logically. Additionally, the formulation of the skills considered the following aspects:

Describing the performance in a short phrase.

Ensuring each phrase measures a specific, clear behavior.

Starting the phrases with behavioral verbs in the present tense.

Describing the subs kills as components of their corresponding main skill.

Quantitative Assessment of the Trainee's Performance: The checklist included two performance options: (Performed the skill – Did not perform the skill).

Instructions for the Observation Checklist: Clear and specific instructions were provided on the first page of the checklist. The instructions guided the observer to read the contents of the checklist, understand the performance options, and the performance levels with their respective quantitative assessments.

Initial Version of the Observation Checklist: After determining the purpose of the checklist and analyzing its main areas into subs kills, the checklist was initially formulated. The checklist consisted of (12) subs kills.

Refinement of the Observation Checklist: This was done through the following procedures:

A- Face Validity of the Observation Checklist: The validity of the tool was assessed to determine whether it measures what it was intended to measure. It was then presented to a panel of (10) faculty members specializing in Educational Technology and Methods of Teaching English. Based on their feedback, some phrases were rewritten and presented in their final form.

B- Internal Consistency of the Items: The internal consistency was verified by calculating the Pearson correlation coefficient between the scores of each item and the total score of the dimension. Table (6) illustrates this:

Table 6: Correlation Coefficients between the Scores of Each Item and the Total Score of the Dimension (N = 30)

Literal Comprehension		Inferential Comprehension		Critical Comprehension		Creative Comprehension	
Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient	Item	Correlation Coefficient
1	0.707	1	0.558	1	0.631	1	0.482
2	0.485	2	0.493	2	0.573	2	0.593
3	0.528	3	0.672	3	0.556		
4	0.664						

It is evident from Table (6) that all items of the observation checklist have positive and statistically significant correlation coefficients at the (0.01) level, indicating that they possess internal consistency.

C- Internal Consistency of the Dimensions with the Total Score:

The correlation coefficients were calculated using Pearson's correlation coefficient between the dimensions themselves on one hand, and between each dimension and the total score on the other hand. Table (7) illustrates this:

Table 7: Correlation Matrix of the Observation Checklist Dimensions

No.	Dimensions	First	Second	Third	Fourth	Total
1	Literal Comprehension					
2	Inferential Comprehension	0.628				
3	Critical Comprehension	0.572	0.614			
4	Creative Comprehension	0.632	0.528	0.475		
	Total Score	0.541	0.472	0.662	0.578	

Significant at the (0.01) Level

Table (6) shows that all correlation coefficients are significant at the (0.01) level, indicating that the instrument has internal consistency.

Reliability of the Observation Checklist:

Reapplication Method: Reliability was assessed by reapplying the instrument after a two week interval to a sample used for verifying psychometric properties. The correlation coefficients between the sample scores were calculated using Pearson's correlation coefficient. All correlation coefficients for the checklist dimensions were significant at the (0.01) level, indicating that the instrument yields approximately the same results when used multiple times under similar conditions. The details are presented in Table (8):

Table 8:Reliability Results of the Observation Checklist Using the Reapplication Method

Dimensions	Correlation Coefficient between First and Second Applications	Significance Level
Literal Comprehension	0.625	0.01
Inferential Comprehension	0.778	0.01
Critical Comprehension	0.832	0.01
Creative Comprehension	0.715	0.01
Total Score	0.731	0.01

It is clear from Table (8) that there is a statistically significant correlation between the first and second applications, indicating its reliability. This confirms the validity of the observation checklist in measuring what it was designed to measure.

Cronbach's Alpha Method: The reliability coefficient of the tool was calculated using Cronbach's Alpha, and all values were high, indicating an appropriate level of reliability. The results are shown in Table (9):

Table 9: Reliability Coefficients of the Observation Checklist Using Cronbach's Alpha

No.	Dimensions	Cronbach's Alpha
1	Literal Understanding	0.771
2	Inferential Understanding	0.759
3	Critical Understanding	0.795
4	Creative Understanding	0.804
Total Score		0.812

It is evident from Table (9) that the reliability coefficients are high, which provides a good indication of the tool's stability. Therefore, it can be used effectively.

11. Experimental Treatment Material:

The ADDIE instructional design model was used in designing and preparing the constructive learning with smart learning applications due to its clarity and simplicity in its steps. This model is also suitable for all types of instructional designs. It consists of five main stages:

1. Analysis Phase: The goal of the educational program was identified, which is "constructive learning using smart applications to enhance reading comprehension skills for an English reading course."

2. Design Phase: The content of the program was prepared, including selecting appropriate multimedia resources, such as images, graphics, videos, and sounds to be employed in teaching the experimental group.

3. Production and Development Phase: In this phase, a Google Classroom account was created for the learning environment, the welcome message and instructions page were added, and multimedia resources were uploaded.

4. Implementation Phase: After ensuring the program's completeness and effectiveness, it was applied to the experimental group, with students guided to join via the provided class link.

5. Evaluation Phase: The program was reviewed by a group of experts in educational technology, and the researcher conducted a pilot test with a sample group to identify any difficulties or issues with navigation, which showed that the program was easy to navigate and suitable for the students.

12. Pre Study Tools Application:

The pretest for reading comprehension skills and the observation checklist were applied to both the experimental and control groups by the researcher.

Ensuring Group Homogeneity:

To ensure the homogeneity of the study groups, the pretest results for the tools (reading comprehension test and observation checklist) were analyzed to identify any differences between the two groups, and the significance of these differences was checked. The groups were confirmed to be homogeneous.

Experiment Implementation:

The experiment was conducted during the second semester of the academic year 1446 AH. The period included the application of both the pretest and posttest, along with the observation checklist. The experimental group students were instructed to read the guidelines and contact the researcher with any questions or inquiries during the learning process**.**

Student Impressions during the Study Experiment:

Some student impressions were recorded during the experiment, including:

All students expressed enjoyment in constructive learning using smart applications.

Students interacted and collaborated, making the learning process more enjoyable and helping achieve its goals.

Post Study Tools Application:

After completing the experiment, the posttest and observation checklist were applied to identify the difference in performance between the experimental and control groups before and after exposure to the program, to determine the effectiveness of constructive learning with smart applications. The posttest tools were applied in the same manner as the pretest.

Statistical Methods Used:

The SPSS statistical analysis program was used for the necessary statistical analysis, along with the following methods:

Pearson correlation coefficient.

Cronbach's alpha coefficient.

13. T-test.

Mean and standard deviation.

Study Results, Discussion, and Interpretation:

Results of the First Hypothesis and Discussion:

The first hypothesis states: The first hypothesis states: "There are no statistically significant differences at the ($\alpha \leq 0.05$) level between the mean scores of the experimental group and the mean scores of the control group in the post-test for the cognitive aspect of reading comprehension skills among graduate students in the English Reading course, in favor of the experimental group". To verify the validity of this hypothesis, the researcher calculated the t-value to compare the mean scores of the experimental and control groups in the posttest for reading comprehension. This is shown in the following table:

Table 10: Tvalue and its statistical significance for the difference between the mean scores of the experimental and control groups in the posttest for reading comprehension skills.

Group	N (Number)	Mean	Standard Deviation	Degrees of Freedom	Table (t) value		Calculated (t) value	Statistical Significance Level	Effect Size (n^2)
Experimental Group	20	22.85	1.87	38	0.05	0.01	33.264	0.01	0.97
Control Group	20	6.10	1.25		2.087	2.845			

N (Number): The number of participants in each group.

The results indicate that the experimental group displayed a significant difference when compared to the control group, with an effect size of 0.97, which is considered very large, demonstrating a strong impact of the intervention.

The previous table shows that the calculated t-value (33.264) is higher than the critical t-value, which is 2.087 at the 0.05 confidence level and 2.845 at the 0.01 confidence level, with 38 degrees of freedom. Furthermore, the effect size is substantial, being greater than 0.8. This confirms that the calculated t-value is notably higher than the table value, implying a statistically significant difference in favor of the posttest. Consequently, the null hypothesis is rejected, and the alternative hypothesis is accepted, which states: "There are statistically significant differences between the mean scores of the experimental and control groups on the posttest for reading comprehension skills, favoring the experimental group.

Second Hypothesis Testing and Discussion:

The second hypothesis states: " Regarding the third hypothesis, which states: "There is no statistically significant relationship at the level ($\alpha \leq 0.05$) between the average scores of male and female students in the experimental group in the post-application of the cognitive test and the reading comprehension skills observation card." To verify this hypothesis, the researcher calculated the t-value to compare the mean scores of the experimental and control groups in the posttest for the observation checklist. This is shown in the following table:

Table 11: T-value and its statistical significance for the difference between the mean scores of the experimental and control groups in the posttest for the observation checklist.

Statistical Data	Skills	N (Number)	Mean (M)	Standard Deviation (SD)	Degrees of Freedom	Critical t Value	t Calculated Value	Statistical Significance Level	Effect Size (n^2)
Experimental Group	Literal Understanding	20	6.5	1	38	2.087	2.845	23.499	0.01
Control Group		20	3.65	0.49					
Experimental Group	Inferential Understanding	20	4.75	0.72	38	2.087	2.845	21.135	0.01
Control Group		20	2.65	0.49					
Experimental Group	Critical Understanding	20	4.35	0.81	38	2.087	2.845	18.173	0.01
Control Group		20	1.45	0.51					
Experimental Group	Creative Understanding	20	2.55	1	38	2.087	2.845	8.166	0.01
Control Group		20	1.5	0.51					
Experimental Group	Total Score	20	18.15	1.93	38	2.087	2.845	32.262	0.01
Control Group		20	10.25	1.07					

It is clear from the previous table that the calculated t-values (23.499, 21.135, 18.173, 8.166, and 32.262) are greater than the table t-values (2.087 at the 0.05 confidence level and 2.845 at the 0.01 confidence level with 38 degrees of freedom). It is also evident that the effect size is large as it exceeds 0.8, except for creative comprehension. From this, it is clear that the calculated t-values are greater than the table t-values, indicating a statistically significant difference in favor of the posttest application. This leads to rejecting the null hypothesis and adopting the alternative hypothesis, which is: "There are statistically significant differences between the mean scores of the experimental and control group students in the posttest in the observation checklist, in favor of the experimental group."

Third: Testing and Discussion of the Third Hypothesis:

Regarding the third hypothesis, which states: " Regarding the third hypothesis, which states: "There is no statistically significant relationship at the level ($\alpha \leq 0.05$) between the average scores of male and female students in the experimental group in the post-application of the cognitive test and the reading comprehension skills observation card." To verify the validity of this hypothesis, the researcher calculated the Pearson correlation coefficient, as shown in the following table:

Table 12: The Relationship between the Scores of the Experimental Group in the Post Test for the Reading Comprehension Test and the Observation Checklist.

Dimensions	Intellectual Fluency	Interpretation	Prediction	Decision Making	Total Score
Literal Comprehension	0.628	0.395	0.619	0.545	0.496
Inferential Comprehension	0.487	0.586	0.593	0.654	0.522
Critical Comprehension	0.608	0.521	0.656	0.598	0.569
Creative Comprehension	0.557	0.578	0.571	0.485	0.674
Total Score	0.594	0.496	0.528	0.571	0.593

**** Significance Level at 0.01**

It is evident from the previous table that there is a statistically significant relationship at the 0.01 significance level between the experimental group's scores in the posttest of reading comprehension and the posttest of the observation checklist. This indicates the rejection of the null hypothesis, and the researcher accepts the alternative hypothesis, which states: "There is a statistically significant relationship at the ($\alpha \leq 0.05$) level between the average scores of the experimental group students in the posttest of reading comprehension and the posttest of the reading comprehension skills observation checklist."

14. Program Effectiveness:

To determine the effectiveness of constructivist learning in developing the reading comprehension skills of postgraduate students in a reading course in English, the researcher calculated Black's adjusted gain percentage and its significance in each skill, and the following table shows this:

Table 13: Adjusted Gain Scores based on Black's method and their significance for reading comprehension skills.

Tool	Mean Pre Test Scores	Mean Post Test Scores	Maximum Score	Adjusted Gain Score	Statistical Significance
Literal Comprehension	1.75	7.25	8	1.57	Statistically Significant
Inferential Comprehension	1.7	6.05	7	1.44	Statistically Significant
Critical Comprehension	2	6.15	7	1.42	Statistically Significant
Creative Comprehension	0.6	3.4	4	1.52	Statistically Significant
Total Score	6.05	22.85	26	1.49	Statistically Significant

From the previous table, it is clear that the adjusted gain ratio for each of the reading comprehension skills is greater than (1.20), which indicates the effectiveness of the proposed program in the areas measured by the reading comprehension skills. This answers the main research question, and these results confirm the previous findings.

These results can be interpreted in light of the followingconsiderations:

Providing educational content using constructivist learning through smart applications that can be used in various forms, such as on computers or smartphones, ensures continuous learning. The researcher noticed students' interest in learning the content and their eagerness to engage with it because it is presented using tools that fit their daily needs, tools they were eager to use in education. This allows them to learn anytime and anywhere, and also involves the use of their personal phones in learning, which increased their motivation and attracted their attention. This aligns with the results of previous studies, including Ardiansyah, W., & Ujihanti, M. (2018), and Mohamed's study (2023), which confirmed that the diversity of content elements provided, and the interaction during sessions between the researcher and students—through texts, static images, animations, illustrations, videos, and other elements—helped grab students' attention towards the content. It also allowed for greater learning opportunities through multiple senses at the same time, with varied stimuli, leading to better retention of information in students' memories. This can be explained by the Cue Summation Theory, which states that the retention of information in a learner's memory is significantly influenced by the combination of interactive media presented in an organized scientific manner.

The structured scientific content of the program, along with the flexibility to provide students with access to information anytime and anywhere, led to continuous and uninterrupted learning. This became a powerful motivator, driving improvements in learning and the achievement of the desired mastery. Additionally, presenting content in small, manageable segments enabled students to fully understand each unit before progressing to the next, while allowing for review and repetition. This approach reinforced overlearning, which is crucial for long-term retention of knowledge. The opportunity for self-directed learning and immediate feedback also helped in enhancing students' reading comprehension skills. Moreover, constructivist learning, facilitated by smart applications, is student-centered, allowing learners to choose the time, place, and pace that best suit their needs. This approach empowered students to take responsibility for their own learning process.

Study Recommendations and Suggestions:

Based on the results of this study, which confirmed the effectiveness of constructivist learning supported by smart applications in developing reading comprehension skills for the English language course, the following recommendations and proposals were presented:

1. Selecting Appropriate Educational Smart Applications for Constructivist Learning: The study recommends the necessity of choosing educational applications that support constructivist learning methods. These applications encourage students to gradually build their knowledge through interactive activities. Examples of such applications include:

Quiz let: To help students memorize and review vocabulary in a structured manner.

FluentU: To provide educational video clips that help students understand linguistic texts through interaction with visual content.

Reading Rockets: This focuses on improving reading comprehension skills by offering effective reading strategies and motivational activities. It is recommended to select applications that encourage active participation and provide continuous performance assessments to ensure a better understanding of texts.

2. Using Interactive Applications to Enhance Reading Comprehension:

The study encourages the use of interactive applications that allow students to ask questions, search for answers, or compare texts to understand content more deeply. These applications can include tools such as:

-Edmodo and Kahoot: To encourage students to interact with texts through quiz-based strategies or by sharing opinions and responses. This type of application helps enhance the student's ability to analyze and infer which positively impacts reading comprehension skills.

3. Integrating Adaptive Learning Technologies in Smart Applications:

Smart applications should be developed to include adaptive learning technologies that assess the student's level of understanding and adjust content based on their needs. For example, customizing texts or exercises according to the student's level in reading comprehension. This technology ensures:

- Providing educational challenges that are appropriate for the student's current level.

- Customizing instructional guidance to adapt to individual student needs.

Advanced self-assessment systems, such as Duolingo or Quizlet, can be integrated to adapt to the student's proficiency in the language.

4. Developing Applications to Support Spaced Repetition:

It is recommended to develop educational applications that support the spaced repetition strategy, a learning technique based on reviewing information gradually and at spaced intervals. This technique enhances long-term memory retention and helps solidify vocabulary and concepts. This technique can be incorporated into applications such as:

- Anki: Dedicated to vocabulary repetition and enhancing reading comprehension.

- Brainscape: This relies on spaced repetition technology to improve the learning process.

15. Future Research Proposals:

1. Conduct a study to investigate the impact of communication applications between students and teachers, such as Google Classroom and Slack, on improving reading comprehension skills.

Through continuous interaction on these platforms, the improvement in reading skills among students can be evaluated.

2. Conduct a study on digital learning platforms, such as Moodle or Edmodo, in enhancing reading comprehension skills, especially in language schools.

The difference in reading comprehension skills using these platforms can be measured compared to traditional methods.

3. Conduct a comparative study between the effectiveness of smart applications and traditional teaching methods in enhancing English reading comprehension skills.

This study could focus on comparing technology-based teaching strategies (such as flipped classrooms) with traditional teaching methods in improving reading comprehension.

4. Study the impact of using a blend of technologies (interactive learning, videos, and adaptive assessments) in developing reading comprehension skills.

The effectiveness of this blend can be determined by comparing it with the use of any of these technologies individually.

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